

IN THE CLAIMS:

1 1. (CURRENTLY AMENDED) A method for operating a pattern matching engine hav-
2 ing a plurality of information storage entries with two or more regular expressions, each
3 regular expression including a plurality of characters and each regular expression associ-
4 ated with a corresponding action to be applied when matching strings are found, the
5 method comprising the steps of:

6 identifying one or more borders within each regular expression, the one or more
7 borders separating the regular expression into a plurality of sub-expressions, each sub-
8 expression having a plurality of sequential characters;

9 loading each of a plurality of entries of the pattern matching engine with the plu-
10 rality of the sequential characters from one of the sub-expressions, wherein the borders
11 are defined by a predetermined sequence of regular expression metacharacters, and the
12 entries stored in content addressable memory (CAM);

13 applying a string from a network message to the entries of the pattern matching
14 engine to search the string simultaneously for sub-expressions from each of the two or
15 more regular expressions;

16 determining ~~in parallel~~ that the sub-expressions of ~~each~~ at least one regular ex-
17 pression ~~matches a match the string within a network message;~~ and

18 executing the corresponding ~~actions~~ action associated with the ~~the~~ that at least one
19 regular expressions expression on the network message.

1 2. (PREVIOUSLY PRESENTED) The method of claim 1 wherein the predetermined
2 sequence of regular expression metacharacters is a first regular expression metacharacter
3 defined to match any one character of the plurality of sequential characters from one of
4 the sub-expressions followed immediately by a second regular expression metacharacter
5 defined to match the one character zero, one, or more times.

1 3. (PREVIOUSLY PRESENTED) The method of claim 1 further comprising a step of
2 organizing at least part of the pattern matching engine into a plurality of sections, and
3 wherein each section of the pattern matching engine is loaded with a plurality of search
4 patterns for a corresponding sub-expression.

1 4. (PREVIOUSLY PRESENTED) The method of claim 3 wherein the plurality of search
2 patterns of a section are loaded with a search pattern that includes a complete match of a
3 respective sub-expression, a search pattern that includes a partial match of the respective
4 sub-expression, and a mismatch pattern.

1 5. (PREVIOUSLY PRESENTED) The method of claim 4 further comprising the steps
2 of:
3 associating at least one sub-expression with a current state variable; and
4 loading the associated current state variable into each entry of a section of the pat-
5 tern matching engine that contains the at least one sub-expression.

1 6. (PREVIOUSLY PRESENTED) The method of claim 5 wherein the pattern matching
2 engine has at least one content addressable memory (CAM) loaded with the two or more
3 regular expressions.

1 7. (PREVIOUSLY PRESENTED) The method of claim 6 wherein
2 the CAM is a ternary content addressable memory, a TCAM, that supports don't
3 care values, and
4 each regular expressions loaded to the CAM has a plurality of search patterns in-
5 cluding a mismatch pattern having don't care values.

1 8. (CANCELLED)

1 9. (CURRENTLY AMENDED) The method of claim 7 wherein each entry of the
2 TCAM identifies a corresponding entry of ~~the~~a second memory device.

1 10. (PREVIOUSLY PRESENTED) The method of claim 9 wherein at least one TCAM
2 entry is associated with a next state variable, the method further comprising the step of
3 loading an entry of the second memory device that is identified by the at least one TCAM
4 entry with the associated next state variable.

1 11. (PREVIOUSLY PRESENTED) The method of claim 10 wherein
2 the at least one TCAM entry is located in a TCAM section whose entries are as-
3 sociated with a current state variable having a first value, and
4 the next state variable has a second value that differs from the first value, wherein
5 the next state variable specifies a new TCAM section to be searched.

1 12. (ORIGINAL) The method of claim 11 wherein each TCAM entry has a match cell
2 that contains the complete match, the partial match or the mismatch pattern.

1 13 – 20. (CANCELLED)

1 21. (PREVIOUSLY PRESENTED) The method of claim 1 wherein
2 the pattern matching engine further includes a second memory device having a
3 plurality of entries, and
4 the entries of the second memory device are loaded with the corresponding ac-
5 tions associated with the two or more regular expressions.

1 22. (CURRENTLY AMENDED) A method for operating a pattern matching engine hav-
2 ing a plurality of information storage entries with two or more regular expressions, each
3 regular expression including a plurality of characters and each regular expression associ-

4 ated with a corresponding action to be applied when matching strings are found, the
5 method comprising the steps of:

6 including at the pattern matching engine at least one ternary content addressable
7 memory (TCAM) that supports don't care values, the at least one TCAM loaded with the
8 two or more regular expressions in TCAM entries;

9 including a second memory device having a plurality of entries for loading actions
10 corresponding to the two or more regular expressions wherein each TCAM entry of the at
11 least one TCAM identifies a corresponding entry of the second memory device;

12 applying a string from a network message to the TCAM to search the string si-
13 multaneously for sub expressions from each of the two or more regular expression;

14 determining in-parallel that the sub-expressions of at least one each regular ex-
15 pression matches-match the a string within a network message; and

16 executing the corresponding actions-action associated with that at least one the
17 regular expressions-expression on the network message.

1 23. (PREVIOUSLY PRESENTED) The method of claim 22 wherein at least one TCAM
2 entry is associated with a next state variable, the method further comprising the step of
3 loading the entry of the second memory device that is identified by the at least one
4 TCAM entry with the associated next state variable.

1 24. (PREVIOUSLY PRESENTED) The method of claim 23 wherein
2 the at least one TCAM entry is located in a TCAM section whose entries are as-
3 sociated with a current state variable having a first value, and
4 the next state variable has a second value that differs from the first value, thereby
5 specifying a new TCAM section to be searched.

1 25. (PREVIOUSLY PRESENTED) The method of claim 24 wherein each TCAM entry
2 has a match cell that contains the complete match, the partial match or the mismatch pat-
3 tern.

1 26. (PREVIOUSLY PRESENTED) An apparatus comprising:

2 means for pattern matching having a plurality of information storage entries with
3 two or more regular expressions, each regular expression including a plurality of charac-
4 ters and each regular expression associated with a corresponding action to be applied
5 when matching strings are found;

6 means for identifying one or more borders within each regular expression, the one
7 or more borders separating the regular expression into a plurality of sub-expressions,
8 each sub-expression having a plurality of sequential characters;

9 means for loading each of a plurality of entries of the means for pattern matching
10 with the plurality of the sequential characters from the sub-expressions, the entries stored
11 in content addressable memory (CAM);

12 means for determining in parallel that the sub-expressions of each regular expres-
13 sion matches a string within a network message; and

14 means for executing the corresponding action associated with the regular expres-
15 sions on the network message.

1 27. (PREVIOUSLY PRESENTED) The apparatus of claim 26, further comprising:

2 means for organizing at least part of the CAM into a plurality of sections, and
3 wherein each section of the CAM is loaded with a plurality of search patterns for a corre-
4 sponding sub-expression.

1 28. (PREVIOUSLY PRESENTED) The apparatus of claim 26, further comprising:

2 means for associating at least one sub-expression with a current state variable; and

3 means for loading the associated current state variable into each entry of the CAM
4 that contains the at least one sub-expression.

1 29. (PREVIOUSLY PRESENTED) The apparatus of claim 26, further comprising:

2 means for including at the pattern matching engine a memory device having a
3 plurality of entries;

4 means for loading the memory device with the corresponding actions associated
5 with the two or more regular expressions.

1 30. (PREVIOUSLY PRESENTED) The apparatus of claim 26, further comprising:

2 means for using a ternary content addressable memory (TCAM) for the CAM,
3 each entry of the TCAM identifying a corresponding entry of the memory device.

1 31. (CURRENTLY AMENDED) An apparatus comprising:

2 a pattern matching engine having a plurality of information storage entries con-
3 figured to store two or more regular expressions, each regular expression including a plu-
4 rality of characters and associated with a corresponding action to be applied to a network
5 message, the pattern matching engine configured to identify one or more borders within a
6 regular expression, the one or more borders separating the regular expression into a plu-
7 rality of sub-expressions, each sub-expression having a plurality of sequential characters,
8 the pattern matching engine configured to apply a string from a network message to the
9 entries to search the string simultaneously for sub-expressions from each of the two or
10 more regular expression and to determine in parallel that the plurality of sequential char-
11 acters from the sub-expressions of each at least one regular expression matches a match
12 the string within the network message, and then to execute the corresponding actions as-
13 sociated with that at least one the regular expression on the network message; and
14 a content addressable memory (CAM), the CAM configured to store the plurality
15 of sequential characters from the plurality of sub-expressions.

1 32. (PREVIOUSLY PRESENTED) The apparatus of claim 31, further comprising:
2 at least part of the CAM organized into a plurality of sections wherein each sec-
3 tion is loaded with a plurality of search patterns for a corresponding sub-expression.

1 33. (PREVIOUSLY PRESENTED) The apparatus of claim 31, further comprising:
2 the pattern matching engine configured to associate each sub-expression with a
3 current state variable; and
4 the pattern matching engine configured to store each associated current state vari-
5 able into a CAM entry that contains at least one sub-expression.

1 34. (PREVIOUSLY PRESENTED) The apparatus of claim 31, further comprising:
2 a second memory device having a plurality of entries, the second memory device
3 configured to store the corresponding actions associated with the two or more regular ex-
4 pressions.

1 35. (PREVIOUSLY PRESENTED) The apparatus of claim 31, further comprising:
2 the CAM configured as a ternary content addressable memory (TCAM), the
3 TCAM storing a corresponding entry for each entry of the second memory device.

1 36. (PREVIOUSLY PRESENTED) A method for operating a pattern matching engine
2 comprising the steps of:
3 obtaining two or more regular expressions;
4 identifying one or more borders within each regular expression using a determi-
5 nistic finite state machine, the one or more borders separating the regular expression into

6 a plurality of sub expressions, each sub expression including one or more characters, each
7 border indicated by one or more predetermined metacharacters;

8 loading separate portions of a memory of the pattern matching engine with the
9 sequential characters from each of the plurality of sub expressions of the two or more
10 regular expressions;

11 applying a string from a network message to the memory to search the string in
12 parallel for sub expressions from each of the two or more regular expression;

13 determining that at least one of the two or more regular expressions matches the
14 string and executing in response thereto a corresponding action associated with that regu-
15 lar expression.

1 37. (PREVIOUSLY PRESENTED) The method of claim 36 wherein the memory is a
2 content addressable memory (CAM).

1 38. (PREVIOUSLY PRESENTED) The method of claim 36 wherein the step of loading
2 further comprises the step of:

3 generating a plurality of search patterns for the sequential characters from each of
4 the plurality of sub expressions and loading these search patterns into the the separate
5 portions of the memory.

1 39. (CURRENTLY AMENDED) An apparatus comprising:

2 a pattern matching engine configured to obtain two or more regular expressions
3 and to identify one or more borders within each regular expression using a deterministic
4 finite state machine, the one or more borders separating the regular expression into a plu-
5 rality of sub expressions, each sub expression including one or more characters, each
6 border indicated by one or more predetermined metacharacters;

7 a memory of the pattern matching engine ~~configured~~configured to store the se-
8 quential characters from each of the plurality of sub expressions of the two or more regu-
9 lar expressions in separate portions of memory, the memory further configured to, in re-
10 sponse to application of a string from a network message, search the string in parallel for
11 sub expressions from each of the two or more regular expression, and to determine that at
12 least one of the two or more regular expressions matches the string; and
13 the pattern matching engine further configured to cause the execution of a corre-
14 sponding action associated with that regular expression that matches.

1 40. (PREVIOUSLY PRESENTED) The apparatus of claim 39 wherein the memory is a
2 content addressable memory (CAM).

1 41. (PREVIOUSLY PRESENTED) The apparatus of claim 39 wherein the memory if
2 further configured to store a plurality of search patterns for the sequential characters of
3 each of the plurality of sub expressions.

1 42. (NEW) The method of claim 36 wherein the deterministic finite state machine is
2 constructed by combining separate deterministic finite state machines of each of the two
3 or more regular expressions into a single deterministic finite state machine that identifies
4 borders in the two or more regular expressions.

1 43. (NEW) The method of claim 36 wherein the deterministic finite state machine is
2 configured to parse regular expressions one character at a time.

1 44. (NEW) The method of claim 43 wherein the deterministic finite state machine is
2 configured to transition between states in response to valid character matches with parsed
3 characters of regular expressions.

1 45. (NEW) The method of claim 36 wherein the one or more predetermined metachar-
2 acters comprise a specific sequence of metacharacters.

1 46. (NEW) The method of claim 45 wherein the specific sequence of metacharacters
2 comprises a first regular expression metacharacter that defines a match to any one charac-
3 ter followed by a second regular expression metacharacter defined to match a preceding
4 element zero, one, or more than one times.

1

2 47. (NEW) The apparatus of claim 39 wherein the deterministic finite state machine is
3 constructed by combining separate deterministic finite state machines of each of the two
4 or more regular expressions into a single deterministic finite state machine that identifies
5 borders in the two or more regular expressions.

6

1 48. (NEW) The apparatus of claim 39 wherein the deterministic finite state machine is
2 configured to parse regular expressions one character at a time.

1 49. (NEW) The apparatus of claim 38 wherein the deterministic finite state machine is
2 configured to transition between states in response to valid character matches with parsed
3 characters of regular expressions.

1 50. (NEW) The apparatus of claim 39 wherein the one or more predetermined metachar-
2 acters comprise a specific sequence of metacharacters.

1 51. (NEW) The apparatus of claim 50 wherein the specific sequence of metacharacters
2 comprises a first regular expression metacharacter that defines a match to any one charac-
3 ter followed by a second regular expression metacharacter defined to match a preceding
4 element zero, one, or more than one times.